Chapter 6

PROPERTIES OF HAZARDOUS CHEMICALS

Objectives

After completing this section, participants will be able to:

- Define hazardous materials according to their dangers in transportation or their threat to the environment.
- Understand the importance of three key terms describing the chemical properties of hazardous materials:
    1) Flash Point to determine how flammable a substance is.
    2) pH to determine how corrosive and reactive a substance is.
    3) Reactivity to determine whether a substance can cause violent reactions or explosions.

Introduction

The next topic is chemical properties. Chemistry can be hard to understand, but if you become familiar with just a few key ideas you will be better prepared to protect yourself and others.

Notes

Notes

A Legal Definition Of Hazardous Material

Because of the high risk of HazMat emergencies during transportation, the Department of Transportation (DOT) regulates some of these materials. For example, the DOT has rules about containers, marking and labeling, during transport.

DOT defines a hazardous material as any substance that is capable of posing an unreasonable risk to. . .

- Health
- Safety
- Property and
- The environment

. . .when transported in commerce.

The hazards these materials pose may be **immediate threats** to health and safety or to property:

- Explosion
- Fire
- Release of immediately poisonous vapor clouds or gas
- Release of radiation

They also may pose **long-term threats** to health and damage to property by contaminating the environment.

Fire And Explosion Hazards

The Fire Triangle

The threat of a fire or explosion represents one of the worst possible hazards to people during a HazMat emergency. In order to have a fire there must be three things:

1) Fuel (which may be in the form of a flammable vapor)
2) Oxygen from the air or other source
3) Heat (or some source of flame or spark).

Flash Point

The flash point is lowest temperature at which a liquid will give off enough vapors to be ignited by an ignition source. The flash point is used to classify the relative fire hazards of liquids. **The <u>lower</u> the Flash Point, the more flammable the substance.**

Examples of Flashpoints

Material	Flashpoint (in F^0)
Gasoline	-45^0
Acetone	0^0
Benzene	12^0
Xylene	84^0
Mineral Spirits	110^0

Flammable and Combustible

- Flammable materials have a flash point less than 100ºF.
- Combustible materials have a flash point range from 100º to 200ºF

<u>Notes</u>

Corrosive And Reactive Materials

Corrosives

Corrosive materials cause destruction to human tissue or other materials.

The two forms of corrosives are:

1) **Acids**, have a pH of less than 7
2) **Bases** (also called *alkalines*), have a pH of greater than 7. Corrosive bases often are referred to as *caustic* (e.g., caustic soda).

A material with a pH of 7 is neutral.

Corrosives must mix with some water to work, but the body is made mostly of water, and there are moist areas around the noise, eyes, and mouth and in the lungs. Solids and liquids may attack these areas just as gases can. Even a solid will contact moisture on the skin and start to corrode. Chlorine gas, mixed with water, creates hydrochloric acid and the water it mixes with could be in your lungs, eyes, or other parts of your body. Anhydrous ammonia works in much the same way but creates a base (or alkali), not an acid.

The strength of a corrosive is the ability of the corrosive material to dissolve the material it contacts. Concentration is the percentage of a substance in a solution. A very low concentration of 2% may be very weak and will not contain enough corrosive material to damage the material it has come in contact with.

Notes

pH

Hydrogen ion concentration (pH) is used to determine if a substance is an acid or a base. It is measured on a pH scale as shown below.

1 2 3 4 5 6 7 8 9 10 11 12 13 14

very acidic neutral very alkaline

pH is a measure of strength not concentration

How harmful or corrosive the material is depends on the combination of both strength and concentration.

Depending on the concentration, compounds with high and low pH values could cause burns, irritate eyes, and irritate the nose and lungs. Substances with pH of less than 2 or greater than 12.5 are legally defined as hazardous waste. Materials with a pH less than 2 or greater than 11.5 will burn skin, eyes, and lungs.

Notes

Reactive Chemicals

During a hazardous materials emergency it is possible that a variety of different substances will be present and some could be incompatible with others. It is important to understand the reactive potential of the chemicals and the special precautions that must be followed when handling or storing these materials.

For example:

- **Air Reactive--**materials that react spontaneously in air.

- **Water - Reactive--**materials that will react with water. For some, such as sodium metal, this may be their only hazard. For others, it may be a subsidiary hazard, as for strong or concentrated acids and bases.

Oxidizers

Oxidizers are materials that supply oxygen or replace oxygen in a reaction. Although explosives contain oxidizers, most oxidizers are not hazardous by themselves. When oxidizers react with other materials, they generate heat and oxygen, which can cause an intensely hot rapidly spreading fire, if enough organic fuel is present.

Exercise

Will it Burn, Blow Up, or React? Chemical Properties

Knowing whether a product will burn, blow up, or react to something else you're using could save your life. This exercise will help you get more familiar with finding that kind of information on a Material Safety Data Sheet. Please use the MSDS that your trainer gives you to answer the questions below.

1. Is this product likely to catch on fire on a winter's day here? How about on a summer's day (outside)? What information helped you answer these questions?

2. What should you keep this product away from? What information helped you to answer this question?

3. Will this material burn your skin or eyes? In other words, is this product an acid or a base? What information helped you to answer this question?

CHEMICAL PROPERTIES

Key Points **6**

1) Hazardous chemicals are those that can harm:

    - People
    - Property
    - The environment

2) The fire triangle says that all three elements (oxygen, fuel, heat) must be present in order for a fire to occur.

3) Flashpoint is the temperature at which a flammable liquid gives off enough vapors that in the presence of an ignition source, can flash.

4) The lower the flashpoint, the higher the fire risk.

5) pH determines if a product is an acid or a base.

6) Very Low and Very high pH (<2 or >12.5) can burn through flesh and metal.

7) Store chemicals of similar pH together.

8) Oxidizers are very reactive materials, and are very hazardous around flammables.

9) Properties of hazardous materials determine how one stores and handles the substances.